

ISO New England Overview and Regional Update



*Vermont House Committee on Energy and
Technology*

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EXTERNAL AFFAIRS



Overview of Presentation

- About ISO New England
- Major Responsibilities
- New England Power System
- Transmission
- Additional Resources
- Appendix: Background Information

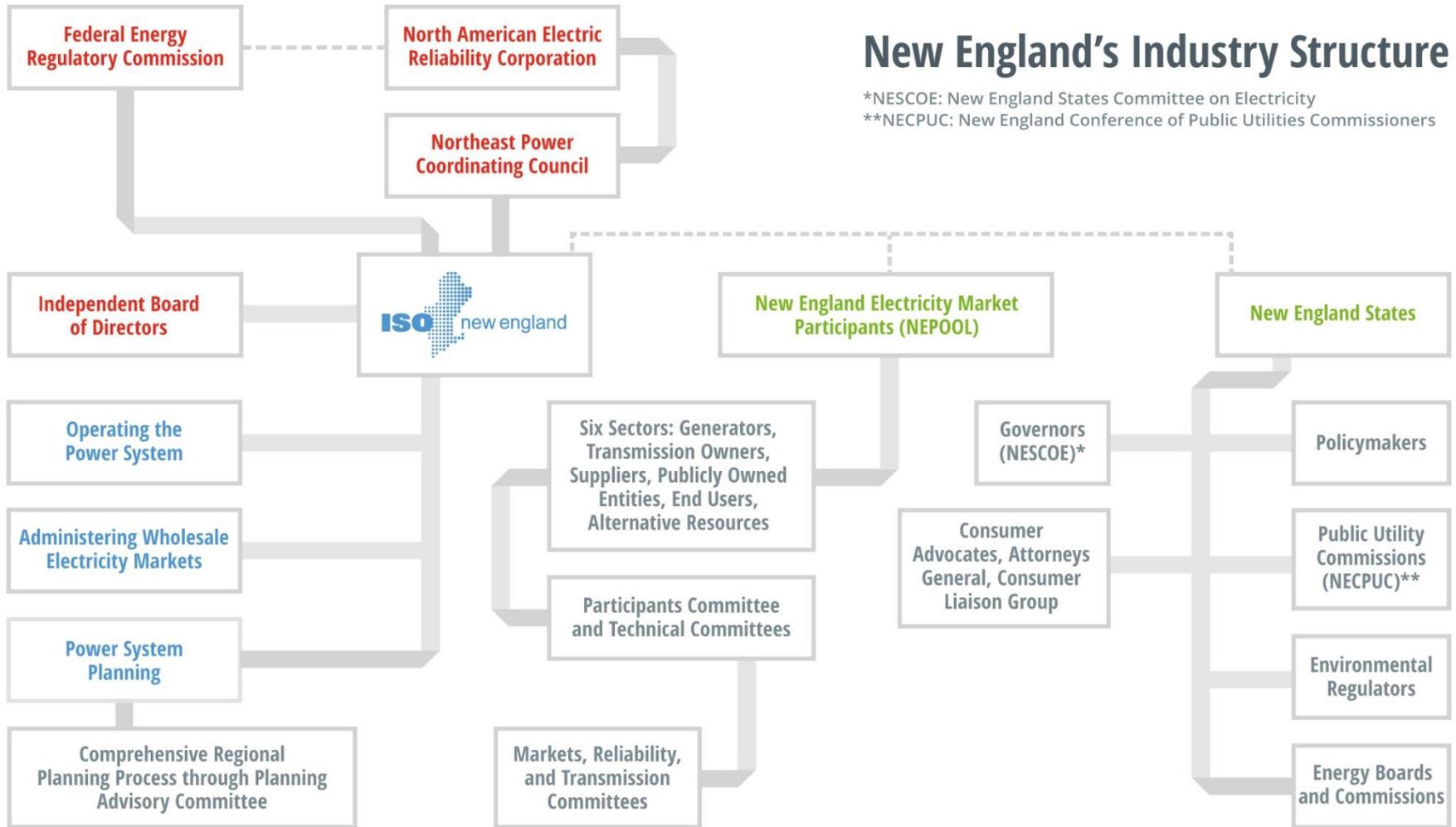


ISO New England (ISO) Has More Than Two Decades of Experience Overseeing the Region's Restructured Electric Power System

- **Regulated** by the Federal Energy Regulatory Commission
- **Reliability Coordinator** for New England under the North American Electric Reliability Corporation
- **Independent** of companies in the marketplace and neutral on technology

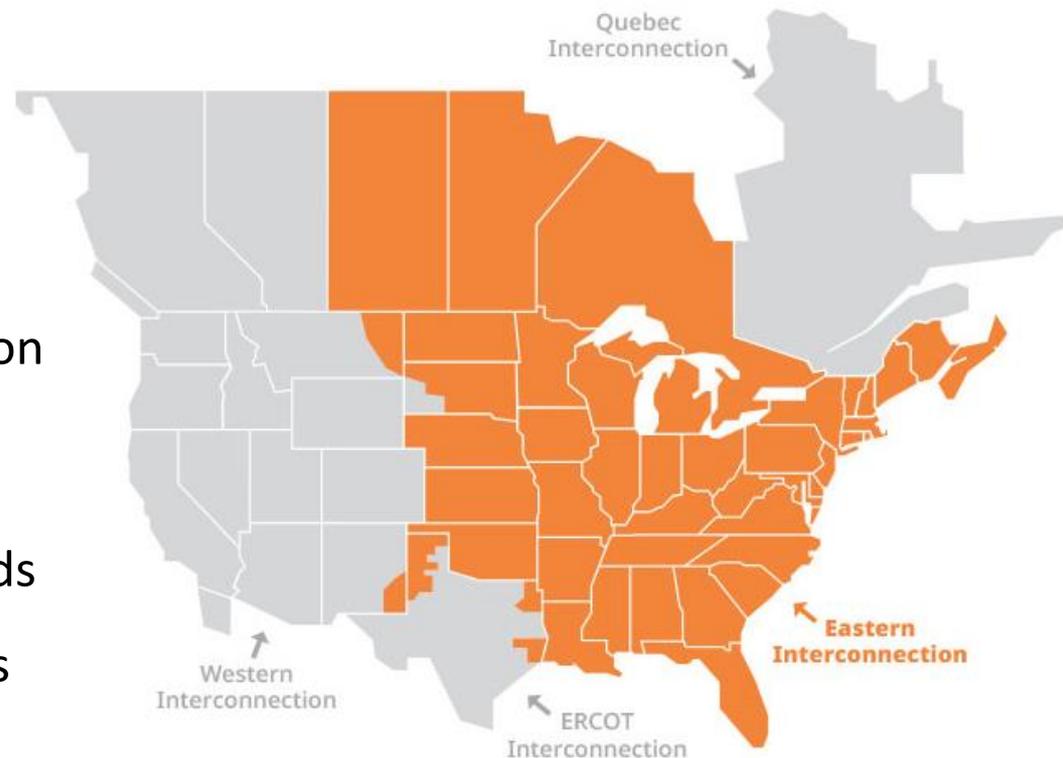


Numerous Entities Including an Independent Board Provide Oversight of and Input on ISO's Responsibilities



New England's Power Grid Is Part of a Larger Electric Power System

- Part of the **Eastern Interconnection**, one of four large power grids in North America
 - Interconnected through primarily alternating current (AC) transmission
- Tied to **Québec** only through direct current (DC) transmission
- 2003 blackout ushered in wide-area monitoring and **mandatory** reliability standards
- Subject to reliability standards set by **NERC** and **NPCC***

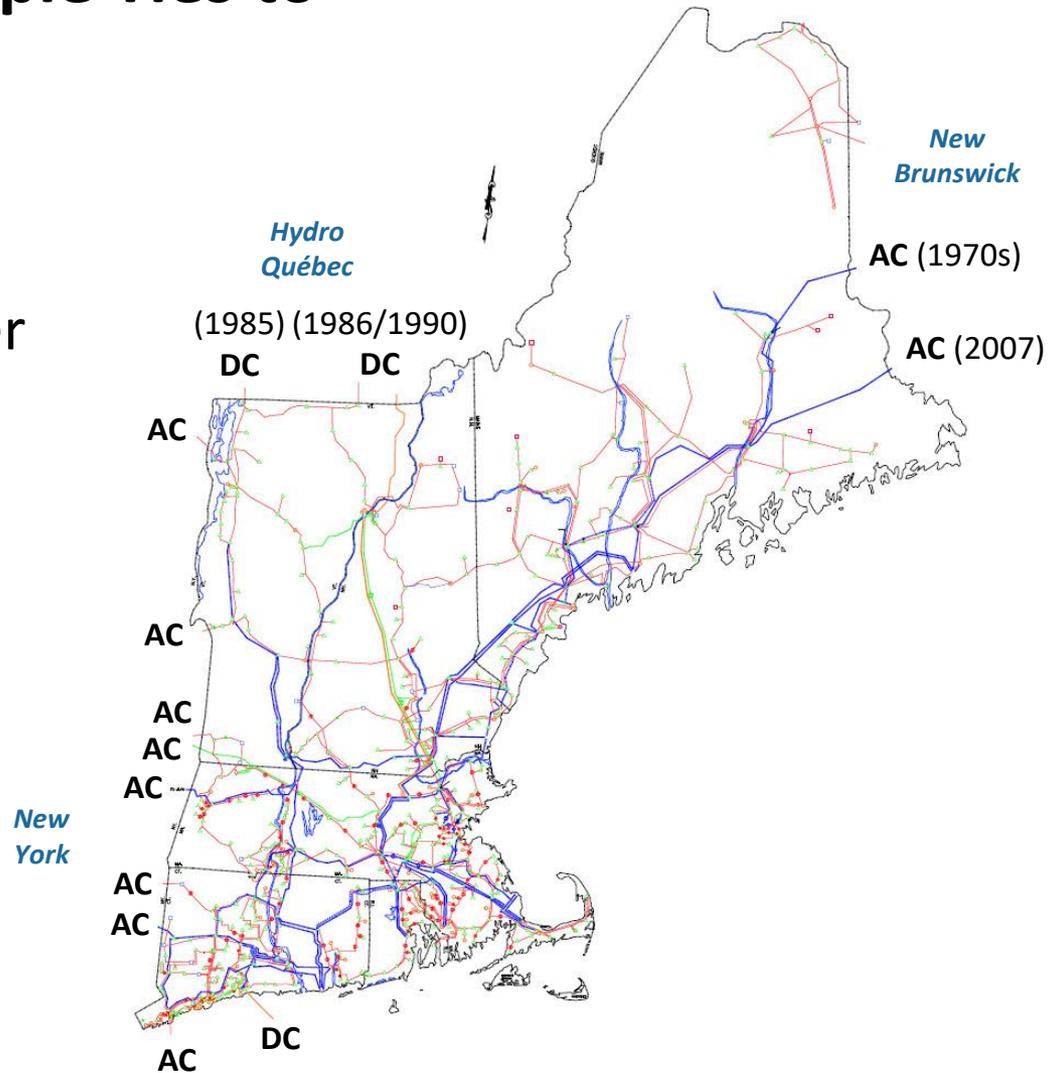


* North American Electric Reliability Corporation (NERC) and Northeast Power Coordinating Council (NPCC)



New England Has Multiple Ties to Neighboring Regions

- Transmission system is tied to neighboring power systems in the U.S. and Eastern Canada:
 - New York (8 AC ties, 1 DC tie)
 - Hydro Québec (2 DC ties)
 - New Brunswick (2 AC ties)
- **20%** of the region's energy needs were met by imports in 2020

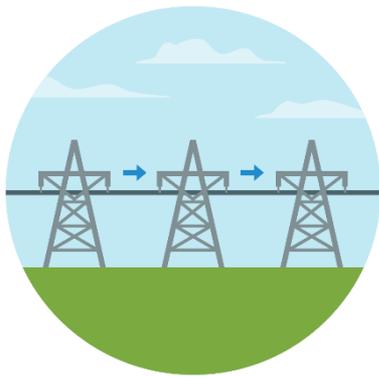


Note: AC stands for Alternating Current and DC stands for Direct Current

ISO New England Performs Three Critical Roles to Ensure Reliable Electricity at Competitive Prices

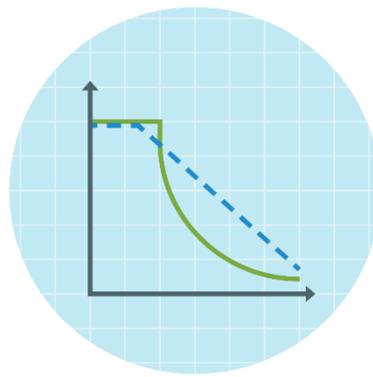
Grid Operation

Coordinate and direct the flow of electricity over the region's high-voltage transmission system



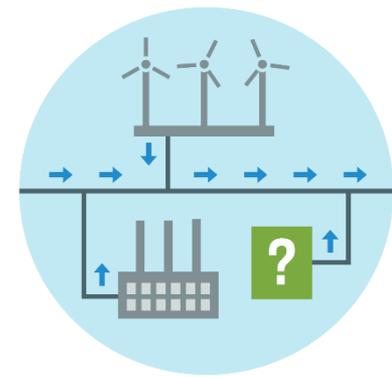
Market Administration

Design, run, and oversee the markets where wholesale electricity is bought and sold



Power System Planning

Study, analyze, and plan to make sure New England's electricity needs will be met over the next 10 years





The image shows a control room operator from behind, looking at a large wall display of a power grid map. The map is filled with various nodes and lines, representing the power grid. The operator is sitting at a desk with several computer monitors. The monitors display various data, including graphs and tables. The overall scene is a busy control room environment.

ISO New England Keeps Power Flowing Across the Region Every Minute of Every Day

Markets Select the Most Cost-Efficient Resources to Meet Current and Future Electricity Needs

Energy Market

Electric Energy: The Day-Ahead and Real-Time Energy Markets are forward and spot markets for trading **electric energy**. Energy prices **fluctuate** throughout the day and at different locations in New England, reflecting the amount of consumer demand, constraints on the system, and the price of fuel that resources use to generate electricity.

Ancillary Markets

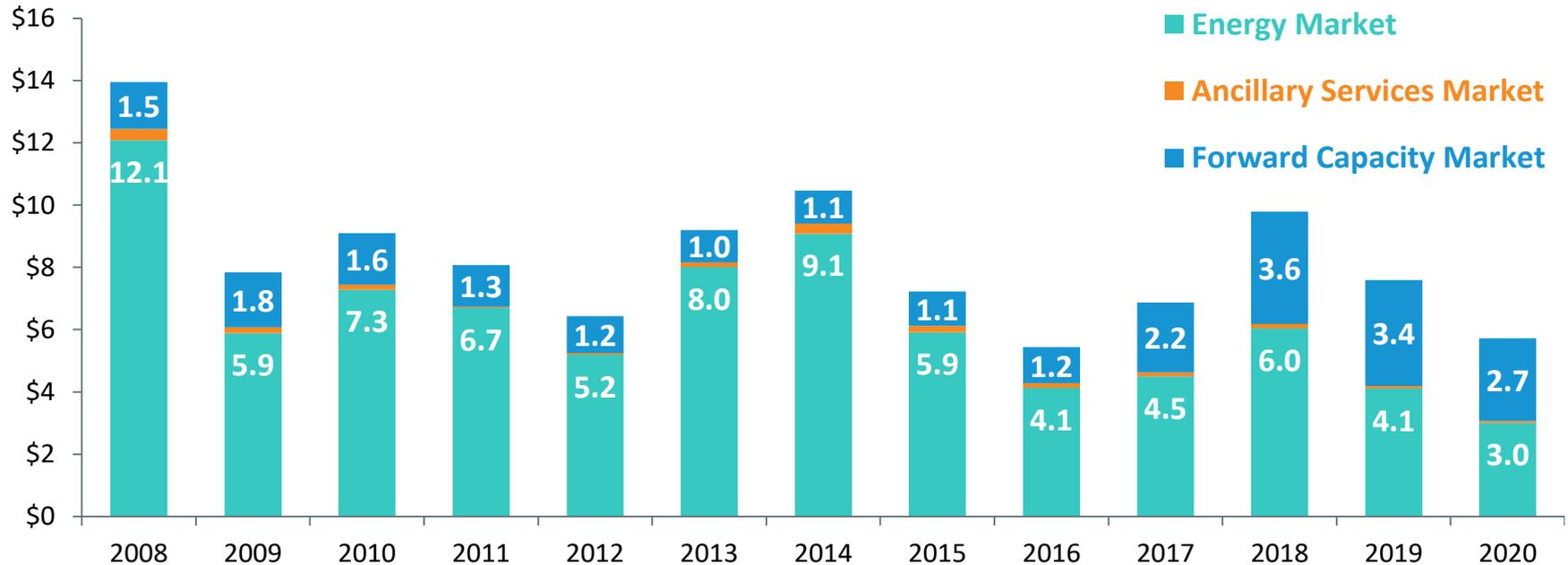
Short-Term Reliability Services: Resources compete in the ancillary markets to provide backup electricity as well as services needed to support the physical operation of the system, such as frequency regulation and voltage support. These services are **critical** during periods of heavy demand or system emergencies.

Forward Capacity Market

Long-Term Reliability Services: Resources compete to sell **capacity** to the system in three years' time through annual Forward Capacity Auctions. The Forward Capacity Market works in tandem with the Energy Markets to **attract** and **sustain** needed power resources today and into the future.

Energy Market Values Vary with Fuel Prices, While Capacity Market Values Vary with Changes in Supply

Annual Value of Wholesale Electricity Markets
(in billions)



Source: [2019 Report of the Consumer Liaison Group](#); 2020 data are subject to adjustment

Note: Forward Capacity Market values shown are based on auctions held roughly three years prior to each calendar year. The 2020 projection is the sum of preliminary 2020 January-October actuals and November-December projected values. The November-December projected values were derived as follows: on average, over the last two years (2018-2019), the value of the Energy Market accrued over the first ten months of the year was approximately 80.90% of the annual total. This percentage was applied to the total from the first ten months of 2020 to produce the November-December Energy Market projections. An analysis of the historical relationship between the Energy Market totals and the Ancillary Services Market totals suggests that the total for the Ancillary Services Market is approximately 2.23% of the Energy Market total. The November-December projections for the Ancillary Services Market represent the value needed to bring the 2020 ten month total to the expected annual total. The Forward Capacity Market values reflect the October 2020 value held constant for the remainder of the year. Please note that this projection is for illustrative purposes only. Data are preliminary and subject to reconciliation.

Demand Patterns Are Changing

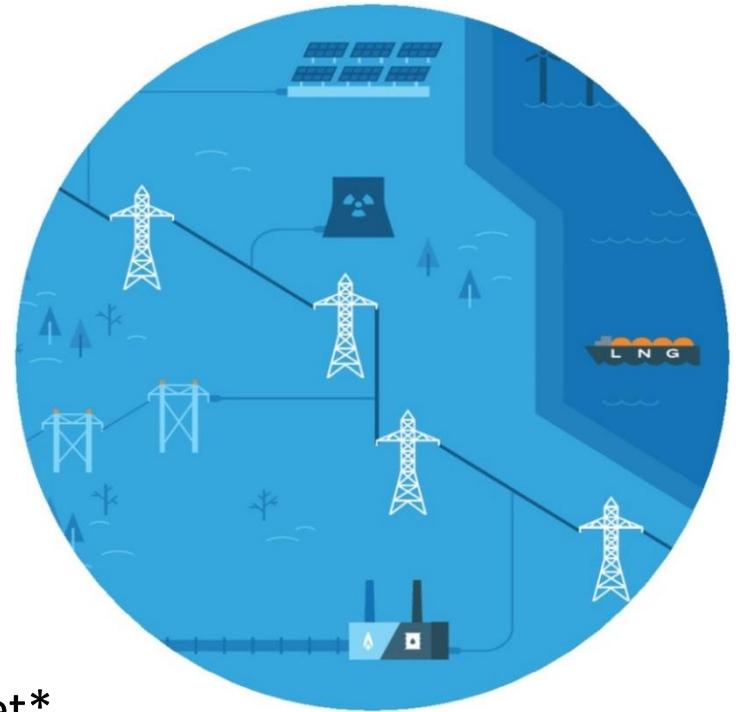


- **7.2 million** retail electricity customers drive the demand for electricity in New England (14.8 million population)
 - Region's all-time summer peak demand: **28,130 MW** on August 2, 2006
 - Region's all-time winter peak demand: **22,818 MW** on January 15, 2004
- Energy efficiency (EE) and behind-the-meter (BTM) solar are **reducing** peak demand growth; electrification of heating & transportation to increase load
 - **-0.2%** annual growth rate for summer peak demand (with EE and BTM solar)
 - **+0.4%** annual growth rate for overall electricity use (with EE and BTM solar)
- BTM solar is **shifting** peak demand later in the day in the summertime

Note: Without energy efficiency and solar, the region's peak demand is forecasted to grow 0.9% annually and the region's overall electricity demand is forecasted to grow 1.4% annually. Summer peak demand is based on the "50/50" forecast for typical summer weather conditions.

Generation and Demand Resources Are Used to Meet New England's Energy Needs

- **350** dispatchable generators in the region
- **31,500 MW** of generating capacity
- Over **24,000 MW** of proposed generation in the ISO Queue
 - Mostly wind, solar, and storage proposals
- Roughly **7,000 MW** of generation have retired or will retire in the next few years
- **400 MW** of active demand response and **2,850 MW** of energy efficiency with obligations in the Forward Capacity Market*
 - Effective June 1, 2018, demand resources have further opportunities in the wholesale markets

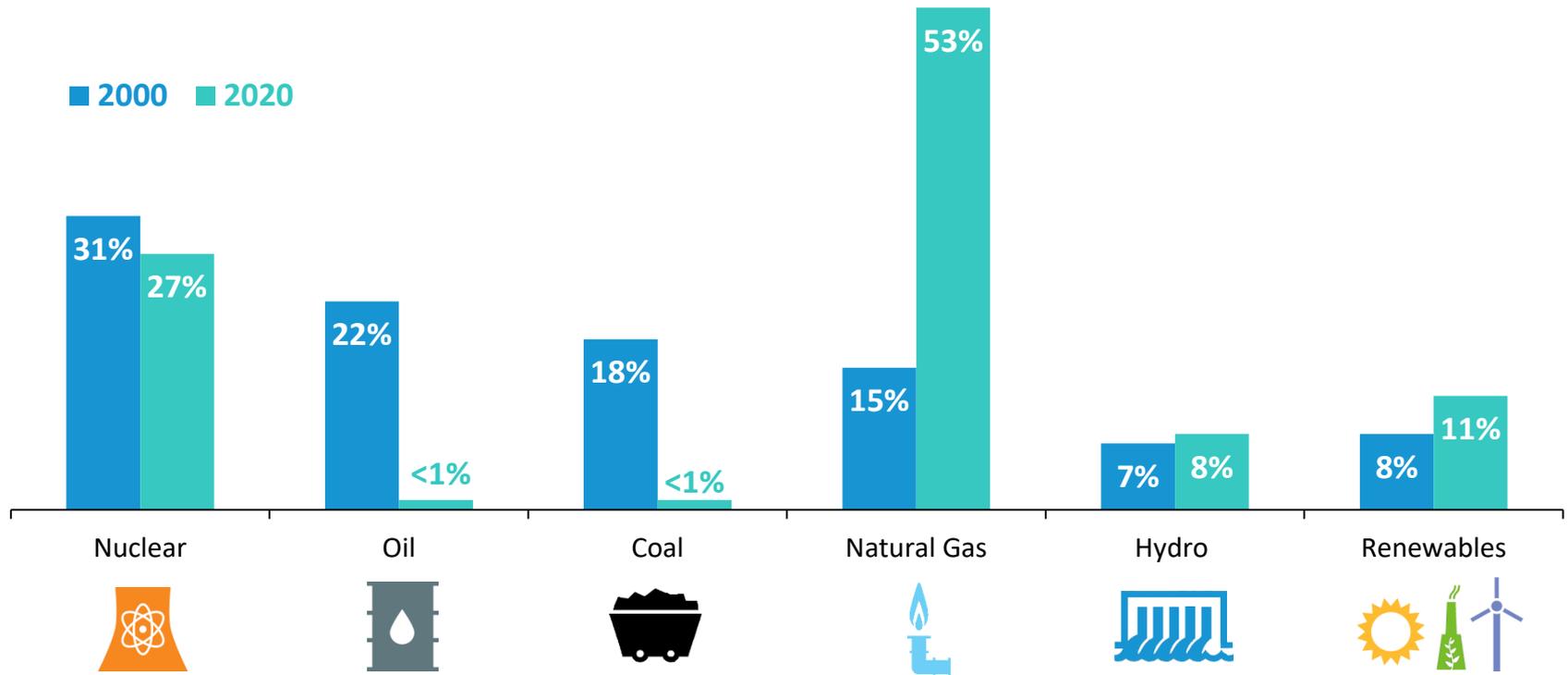


* In the Forward Capacity Market, demand-reduction resources are treated as capacity resources.

Dramatic Changes in the Energy Mix

The fuels used to produce the region's electric energy have shifted as a result of economic and environmental factors

Percent of Total **Electric Energy** Production by Fuel Type
(2000 vs. 2020)



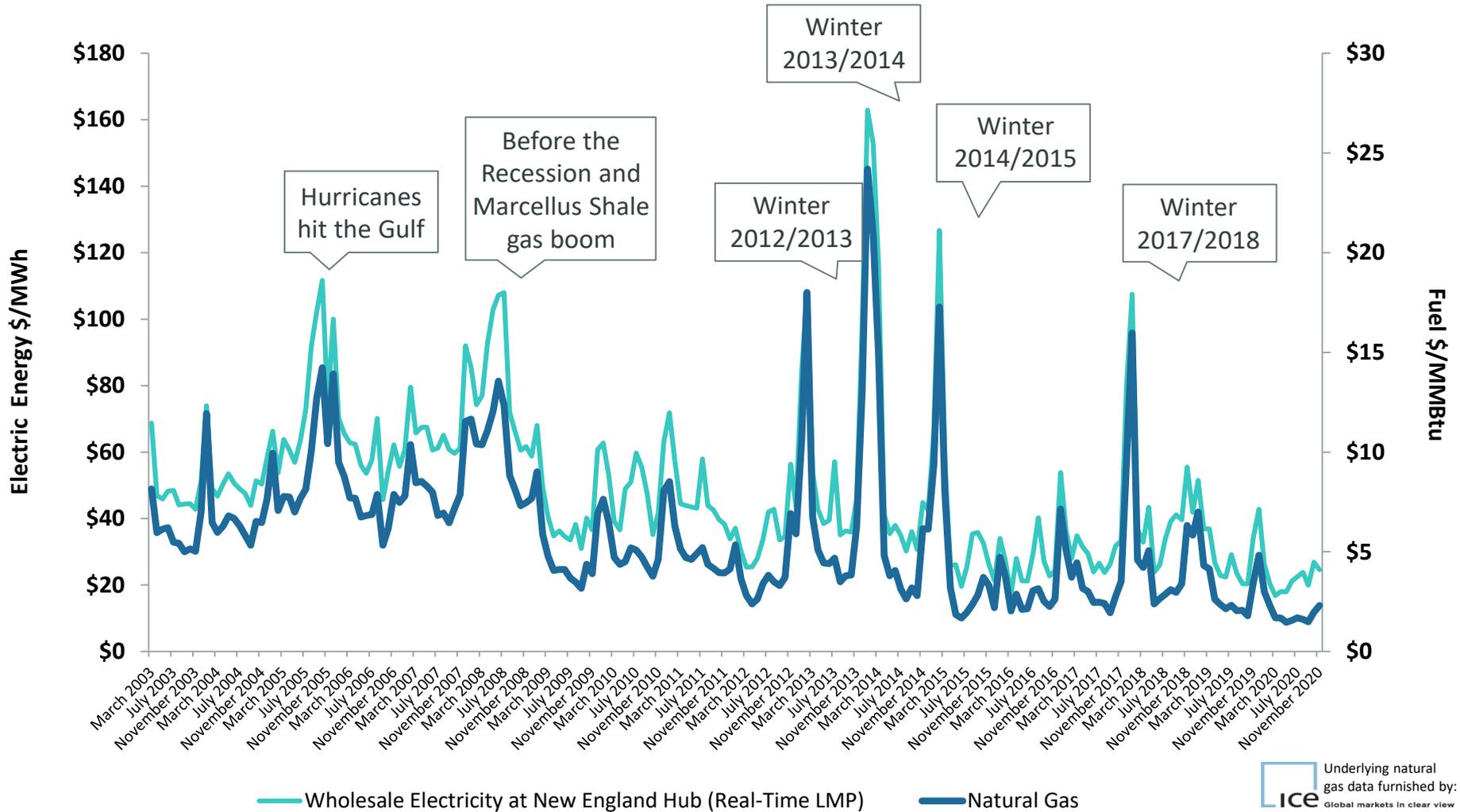
Source: ISO New England [Net Energy and Peak Load by Source](#); data for 2020 is preliminary and subject to resettlement

Renewables include landfill gas, biomass, other biomass gas, wind, grid-scale solar, municipal solid waste, and miscellaneous fuels.

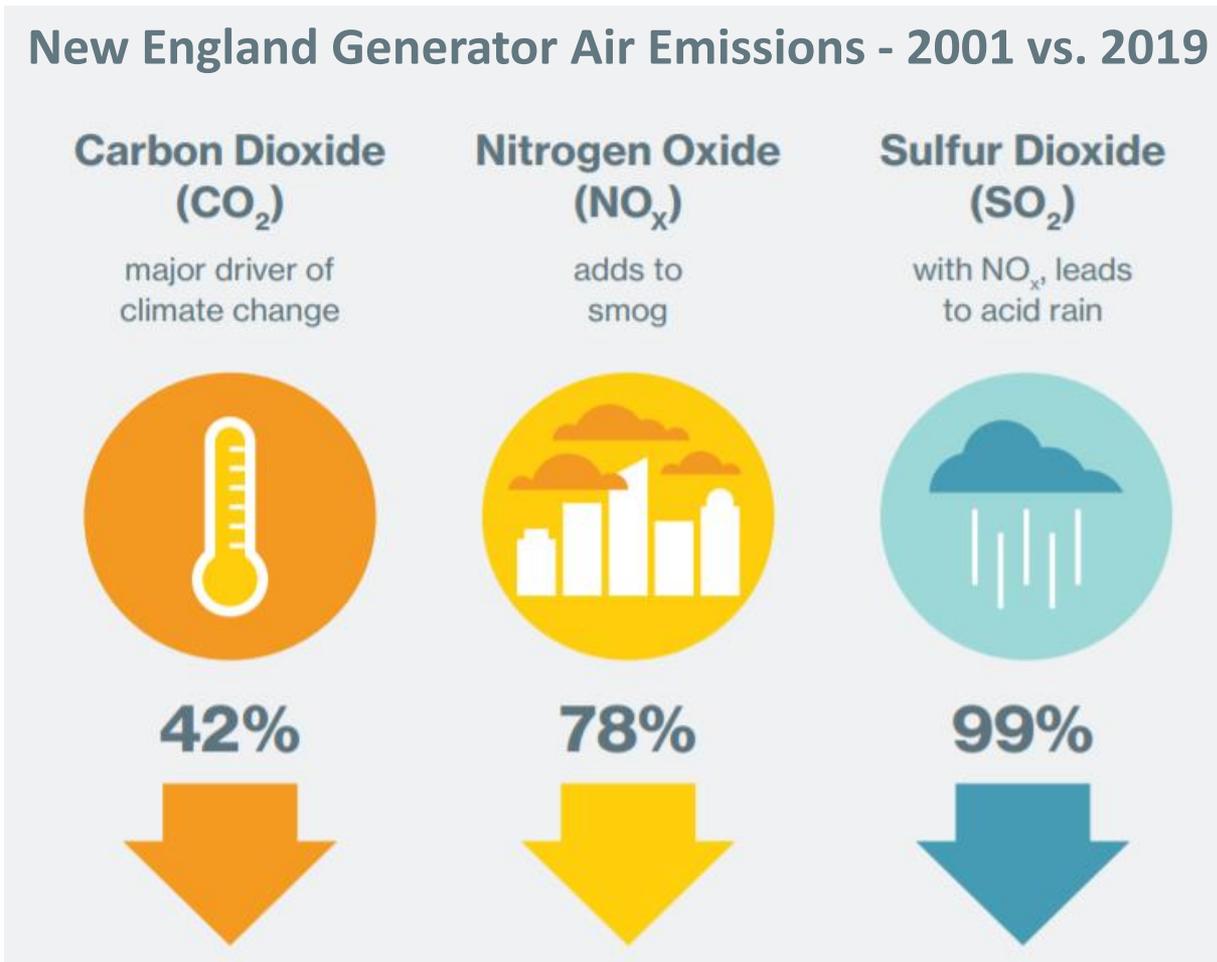
This data represents electric generation within New England; it does not include imports or behind-the-meter (BTM) resources, such as BTM solar.

Natural Gas and Wholesale Electricity Prices Are Linked

Monthly average natural gas and wholesale electricity prices at the New England hub



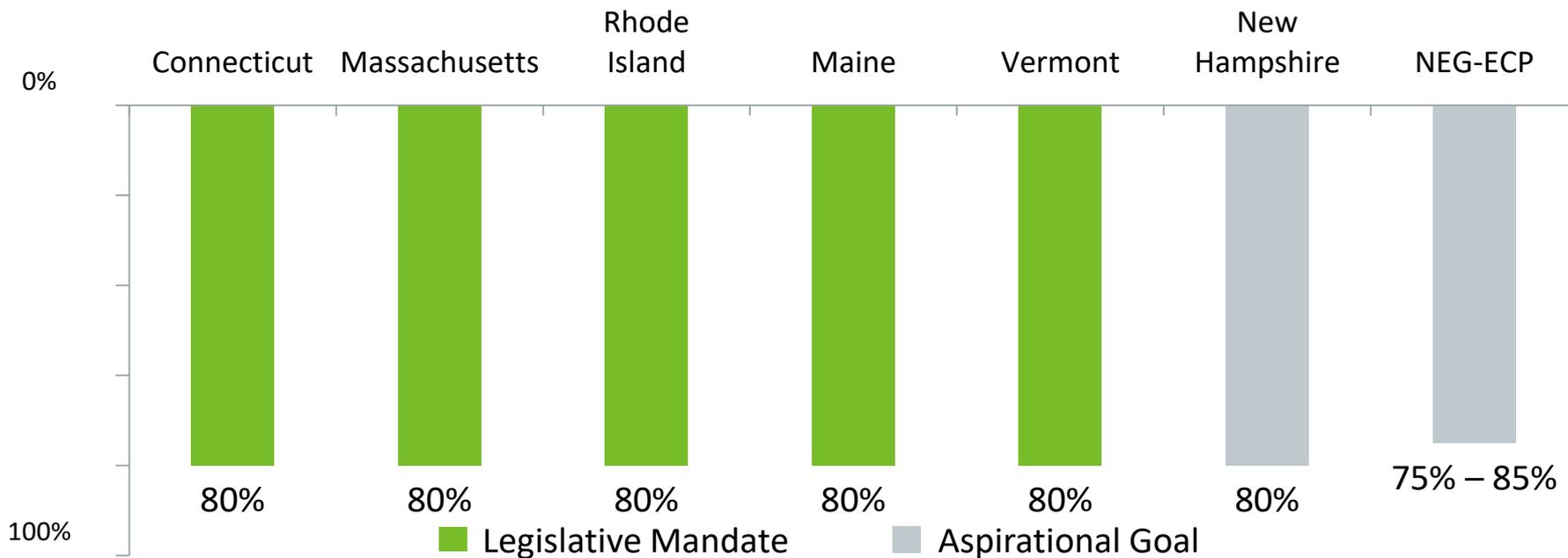
Power Plant Emissions Have Declined with Changes in the Fuel Mix



Appendix Table 4, ISO New England System Annual Generator Emissions, 2001 to 2019 (kilotons)
<https://www.iso-ne.com/committees/planning/environmental-advisory/?document-type=Emissions%20Reports>

States Have Set Goals for Reductions in Greenhouse Gas Emissions: *Some Mandated, Some Aspirational*

Percent Reduction in Greenhouse Gas (GHG) Emissions Economy Wide by 2050*



The New England states are promoting GHG reductions on a state-by-state basis, and at the regional level, through a combination of legislative mandates (e.g., CT, MA, RI, ME, and VT) and aspirational, non-binding goals (e.g., NH and the New England Governors and Eastern Canadian Premiers)

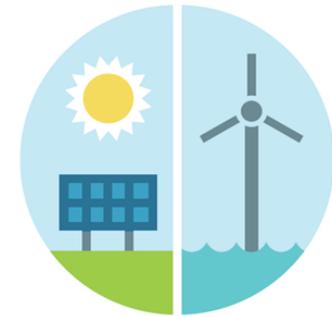
MA, RI, NH, ME, and VT use a 1990 baseline year for emissions reductions. CT and the NEG-ECP use a 2001 baseline. For more information, see the following ISO Newswire article: <https://isonewswire.com/2021/01/19/the-new-england-states-frameworks-for-reducing-greenhouse-gas-emissions-continue-to-evolve/>

States Target Increases in Renewable and Clean Energy and Deep Reductions in CO₂ Emissions

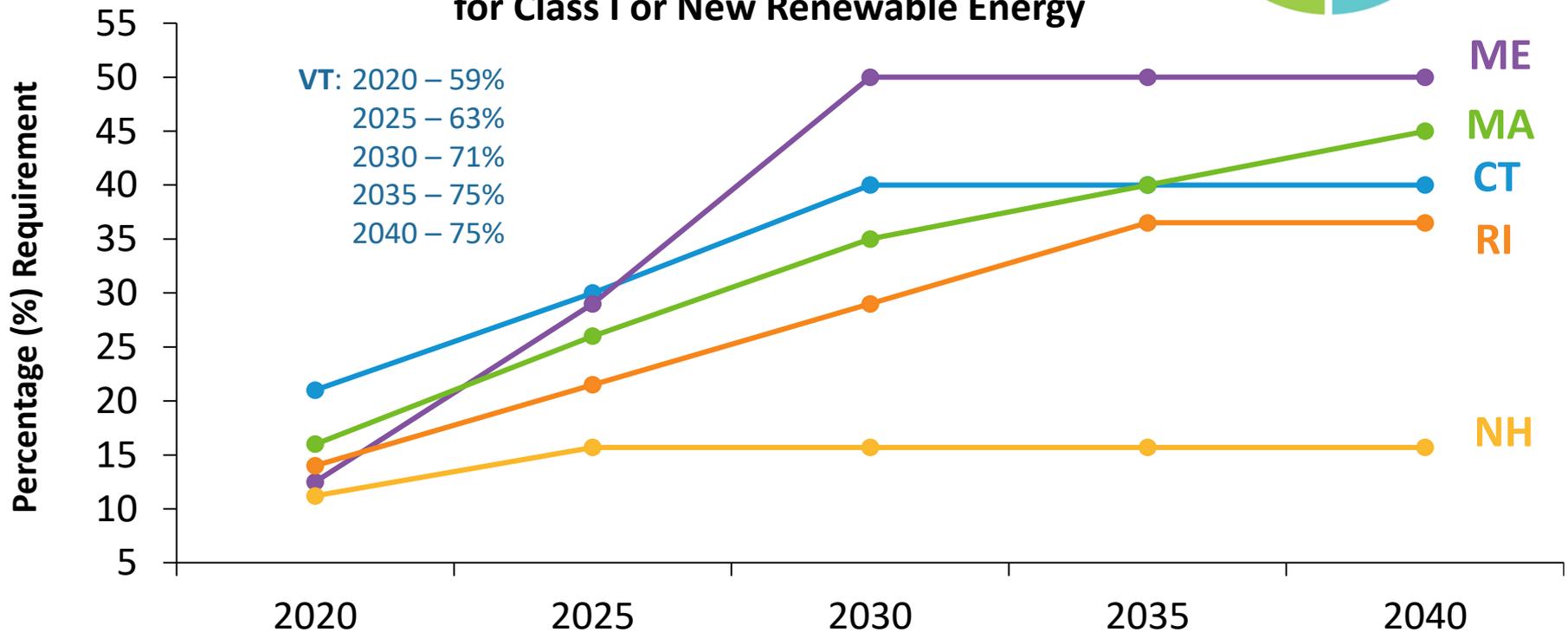
≥80% by 2050	Five states mandate greenhouse gas reductions economy wide: MA, CT, ME, RI, and VT (mostly below 1990 levels)
80% by 2050 Net-Zero by 2050	MA statewide GHG emissions limit MA clean energy standard
90% by 2050	VT renewable energy requirement
100% by 2050 Carbon-Neutral by 2045	ME renewable energy requirement ME emissions goal
100% by 2040	CT zero-carbon electricity goal
100% by 2030	RI renewable energy goal

Renewable Energy Is on the Rise

State policy requirements are a major driver



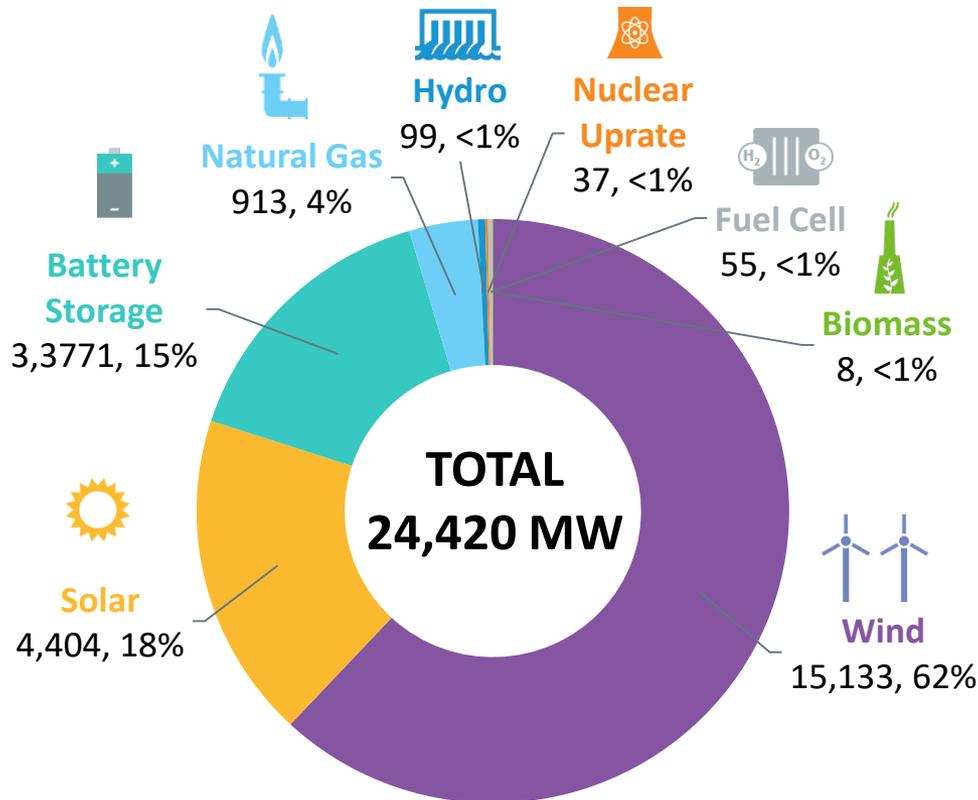
State Renewable Portfolio Standard (RPS)* for Class I or New Renewable Energy



Notes: State RPS requirements promote the development of renewable energy resources by requiring electricity providers (electric distribution companies and competitive suppliers) to serve a minimum percentage of their retail load using renewable energy. Connecticut's Class I RPS requirement plateaus at 40% in 2030. Maine's Class I/IA RPS requirement increases to 50% in 2030 and remains at that level each year thereafter. Massachusetts' Class I RPS requirement increases by 2% each year between 2020 and 2030, reverting back to 1% each year thereafter, with no stated expiration date. New Hampshire's percentages include the requirements for both Class I and Class II resources (Class II resources are new solar technologies beginning operation after January 1, 2006). New Hampshire's Class I and Class II RPS requirements plateau at 15.7% in 2025. Rhode Island's requirement for 'new' renewable energy plateaus at 36.5% in 2035. Vermont's 'total renewable energy' requirement plateaus at 75% in 2032; it recognizes all forms of new and existing renewable energy and is unique in classifying large-scale hydropower as renewable.

Wind Power Comprises Two Thirds of New Resource Proposals in the ISO Interconnection Queue

All Proposed Resources



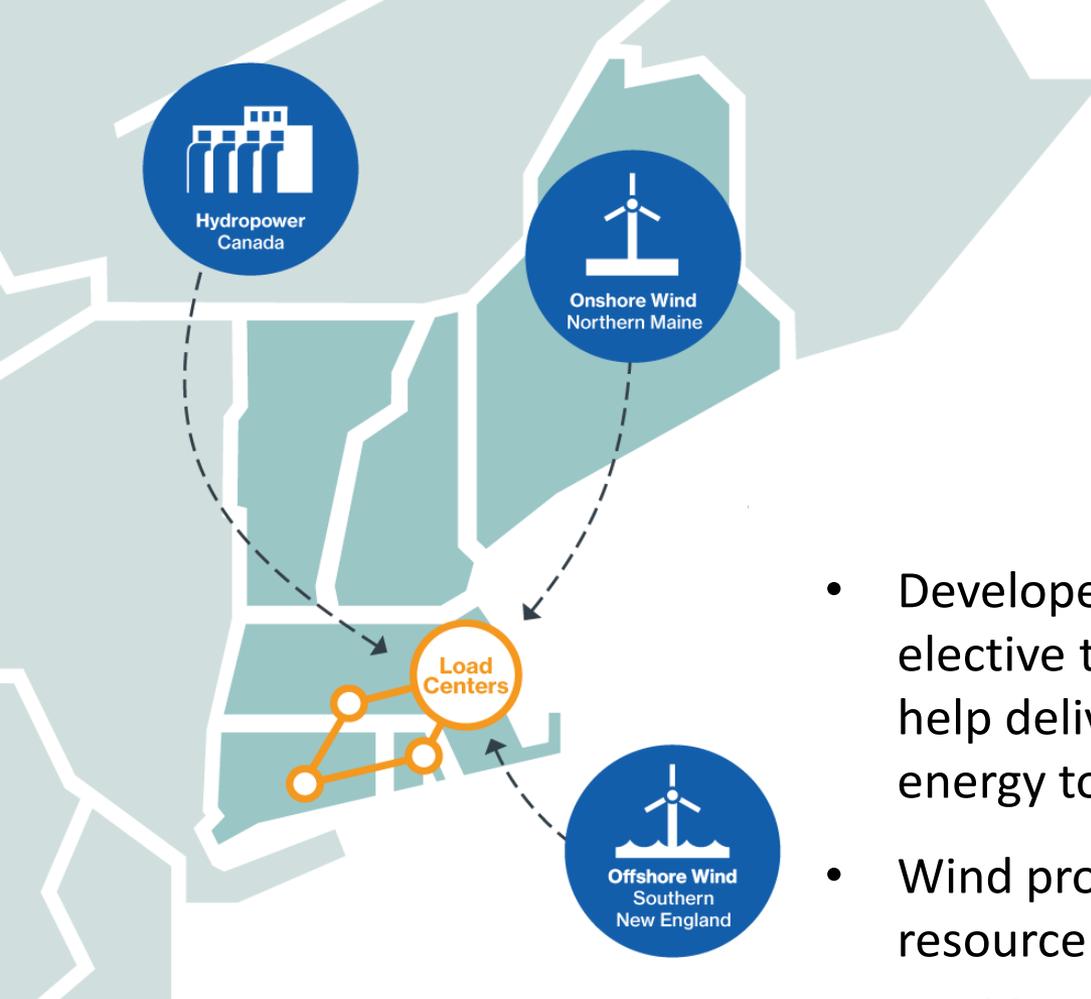
Source: ISO Generator Interconnection Queue (February 2021)
 FERC and Non-FERC Jurisdictional Proposals; Nameplate Capacity Ratings
 Note: Some natural gas proposals include dual-fuel units (with oil backup).
 Some natural gas, wind, and solar proposals include battery storage.

Proposals by State

(all proposed resources)

State	Megawatts (MW)
Massachusetts	12,540
Connecticut	7,653
Maine	2,260
Rhode Island	1,331
New Hampshire	531
Vermont	105
Total	24,420

Source: ISO Generator Interconnection Queue (February 2021)
 FERC and Non-FERC Jurisdictional Proposals



Developers Are Proposing Large-Scale Transmission Projects to Deliver Clean Energy to Load Centers

- Developers are proposing 10 elective transmission upgrades (ETUs) to help deliver about **3,400 MW** of clean energy to New England load centers
- Wind projects make up roughly **62%** of new resource proposals in the ISO Queue
 - Most are offshore wind proposals in southern New England, but some are onshore wind proposals in northern New England and **would require transmission** to deliver the energy to load centers

Lines represent types of ETUs private developers have proposed in recent years

Source: [ISO Interconnection Queue](#) (February 2021)

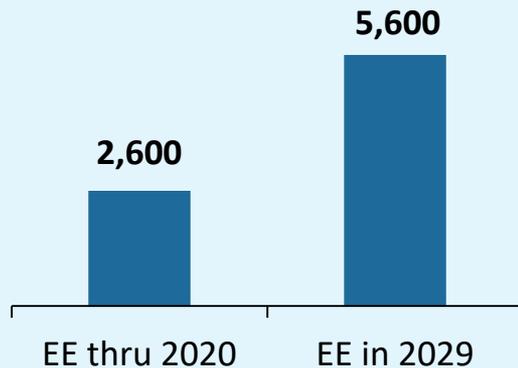
New Energy Storage Technologies Are Coming On Line

- **20 MW** of grid-scale battery storage projects have come on line since late 2015
- Over **3,700 MW** of grid-scale stand-alone energy storage projects are requesting interconnection
- New England has a successful history of operating the region's two large pumped-storage facilities, which can supply **1,800 MW** of power within 10 minutes for up to 7 hours



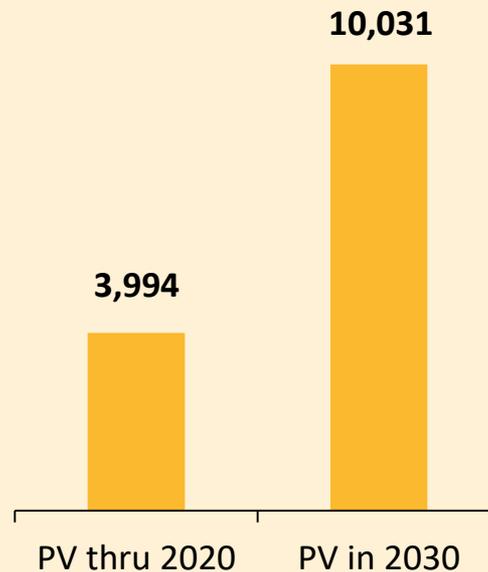
Energy-Efficiency and Renewable Resources Are Trending Up in New England

Energy Efficiency (MW)



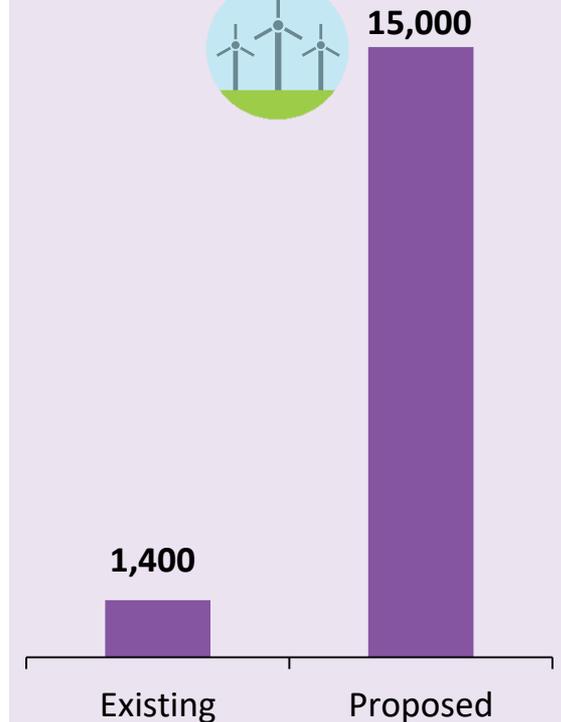
Final 2020 CELT Report, EE through 2019 includes EE resources participating in the Forward Capacity Market (FCM). EE in 2029 includes an ISO-NE forecast of incremental EE beyond the FCM.

Solar (MW)



Draft 20201 ISO-NE PV Forecast, AC nameplate capacity from PV resources participating in the region's wholesale electricity markets, as well as those connected "behind the meter."

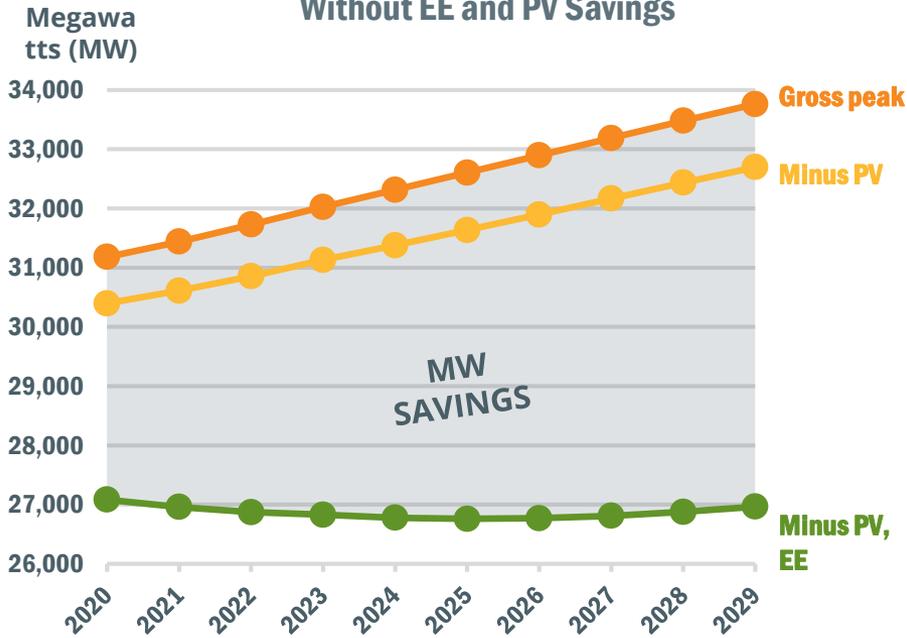
Wind (MW)



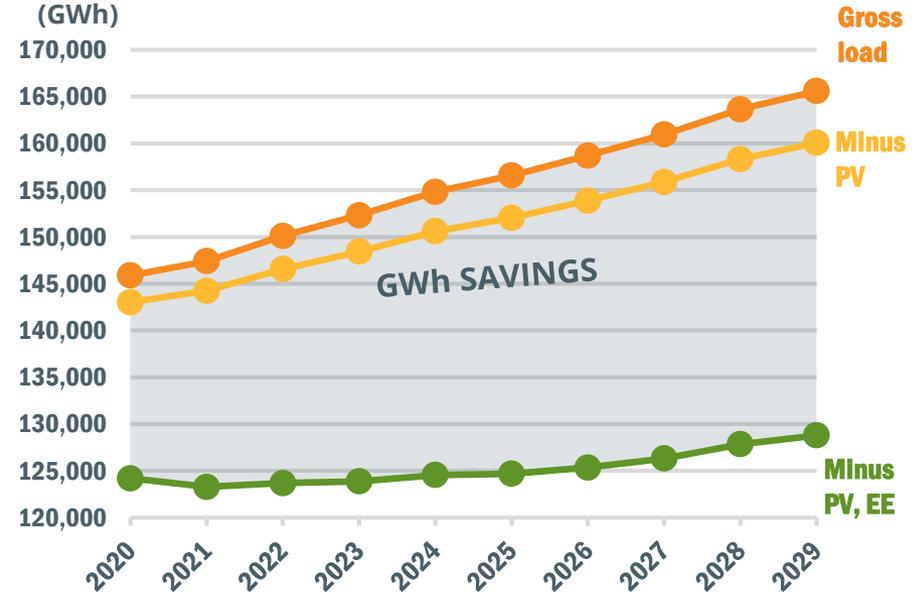
Nameplate capacity of existing wind resources and proposals in the ISO-NE Generator Interconnection Queue (February 2021)

Energy Efficiency and Behind-the-Meter Solar Are Reducing Peak Demand and Annual Energy Use

Projected Summer Peak Demand With and Without EE and PV Savings



Projected Annual Energy Use With and Without EE and PV Savings



The gross load forecast (projected regional energy use)



The gross load forecast minus existing and anticipated behind-the-meter (BTM) solar photovoltaic (PV) resources



The gross load forecast minus existing and anticipated BTM PV and energy-efficiency (EE)

Note: Summer peak demand is based on the “90/10” forecast, which accounts for the possibility of summer weather temperatures of about 94° F.

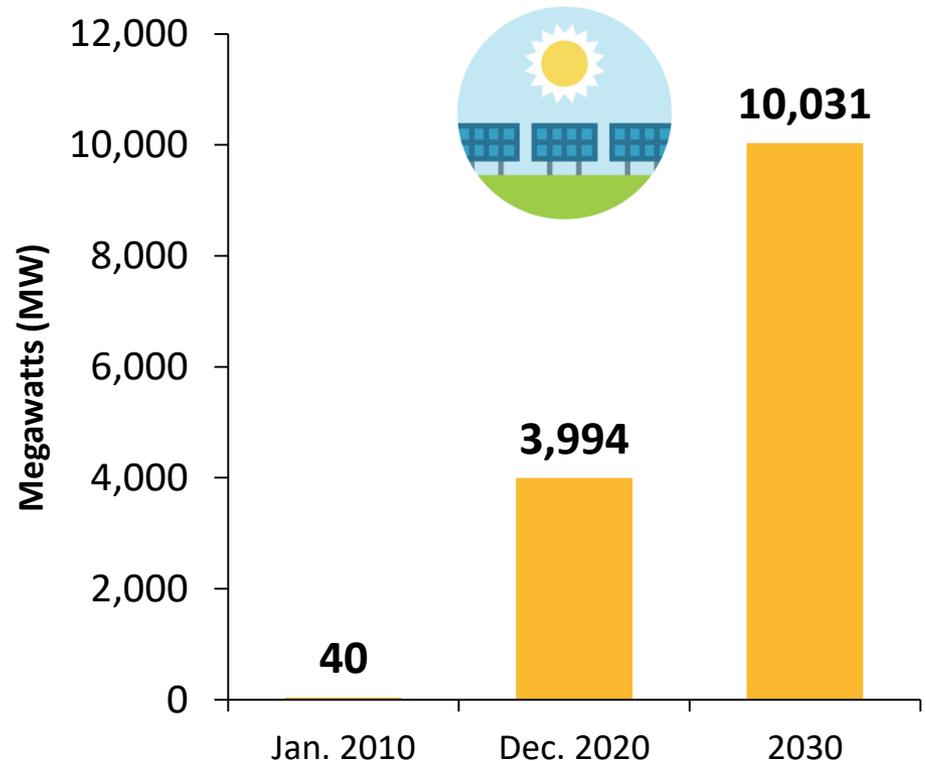
Source: [ISO New England 2020-2029 Forecast Report of Capacity, Energy, Loads, and Transmission](#) (2020 CELT Report) (May 2020)

ISO New England Forecasts Strong Growth in Solar Photovoltaic (PV) Resources

December 2020 Solar PV Installed Capacity (MW_{ac})

State	Installed Capacity (MW _{ac})	No. of Installations
Connecticut	682.3	53,758
Massachusetts	2,502.3	114,487
Maine	66.9	5,591
New Hampshire	125.3	10,757
Rhode Island	223.8	9,688
Vermont	393.9	15,328
New England	3,994.4	199,868

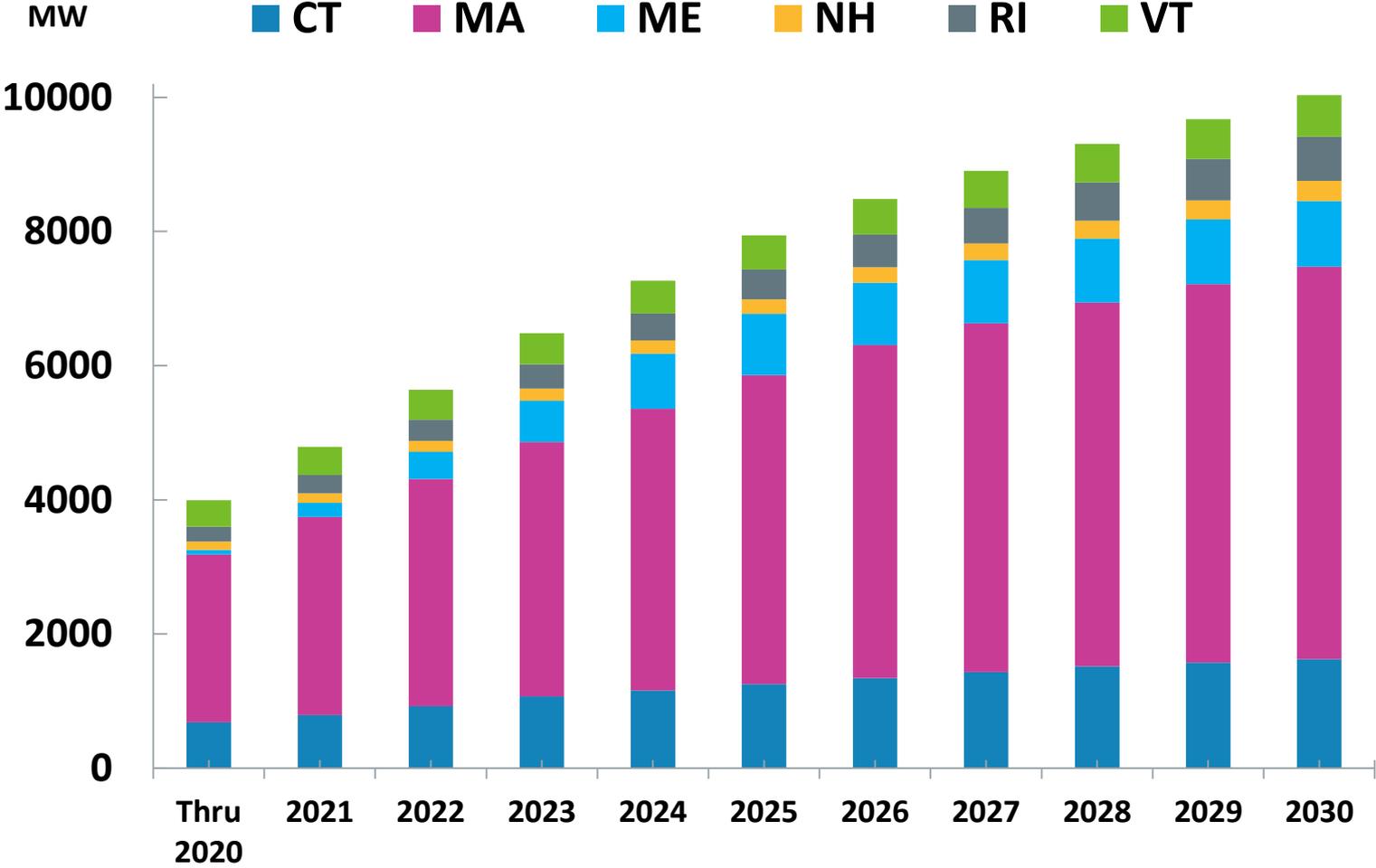
Cumulative Growth in Solar PV through 2030 (MW_{ac})



Note: The bar chart reflects the ISO's projections for nameplate capacity from PV resources participating in the region's wholesale electricity markets, as well as those connected "behind the meter." The forecast does not include forward-looking PV projects > 5 MW in nameplate capacity. Source: [Draft 2021 PV Forecast](#) (February 2021) and [December 2020 Distributed Generation Survey Results](#); MW values are AC nameplate.

Final Draft 2021 Solar PV Forecast

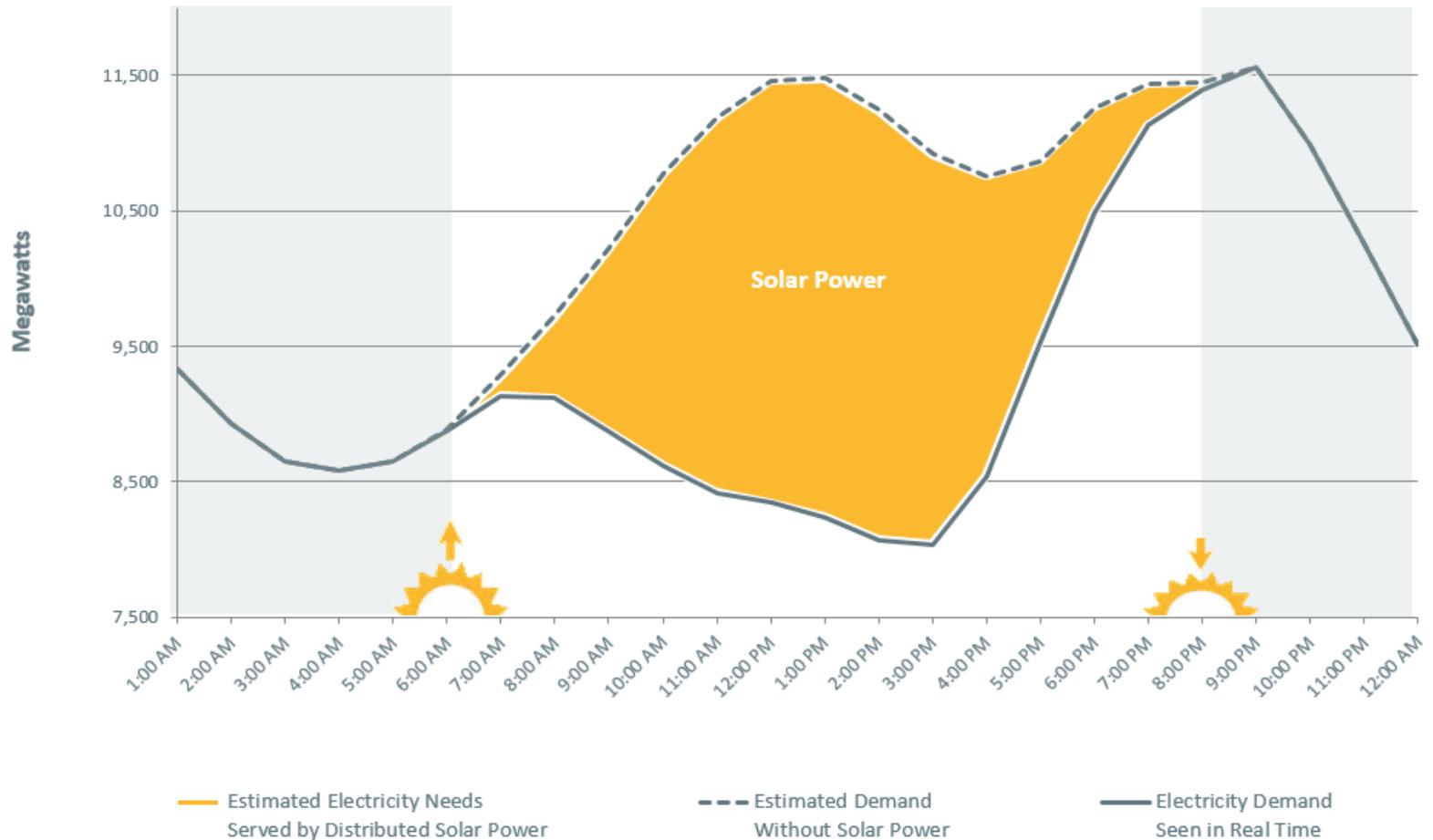
Cumulative Nameplate Installed, MW_{ac}



Source: Final 2021 PV Forecast. Available at https://www.iso-ne.com/static-assets/documents/2021/03/final_2021_pv_forecast.pdf

Region Experienced Historic Dip in Midday Demand with Record-High Solar Power Output on May 2, 2020

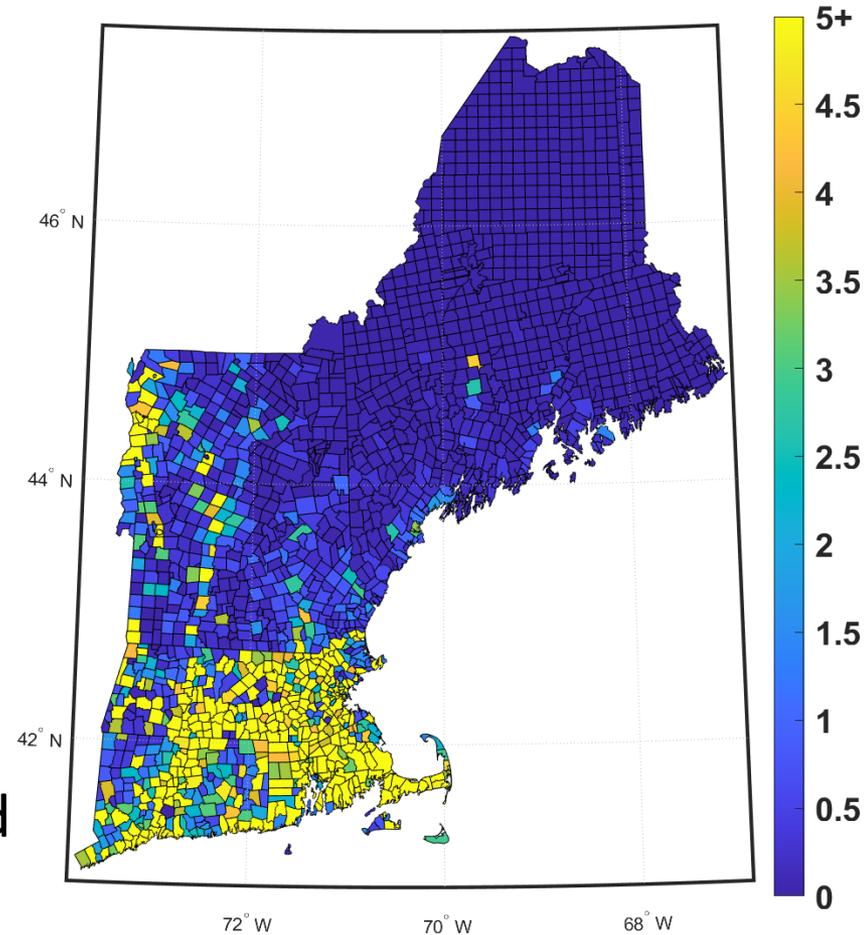
In Hour Ending 13, behind-the-meter solar reduced grid demand by more than 3,200 MW



Source: ISO New England

State Installed Solar PV “Heat Maps”

- Understanding the spatial distribution of existing solar PV resources will be critical to the ISO’s ongoing integration activities within both System Planning and System Operations
- Based on the data provided by distribution owners, the ISO has aggregated the installed nameplate capacity by town within each state, and generated heat maps showing the results



Note: Heat map reflects MW of solar PV installed through December 2020.

The ISO Has Begun Ten-Year Forecasts for Heating Electrification and Light-Duty Electric Vehicles

- The ISO seeks to capture the growth in **air source heat pumps** and electrified **light-duty vehicles** and quantify the resulting increases in electricity demand
- ISO staff work extensively with stakeholders to develop assumptions
- The 2021 Capacity, Energy, Loads, and Transmission Report (CELT Report) will be the **second** to include these estimates
- Details **regarding methodology, assumptions, and calculations** are available at the website of the [Load Forecast Committee](#)



The 2021 Forecast Shows Growth in EV Adoption

Final EV Adoption Forecast							
Year	CT	MA	ME	NH	RI	VT	NE
2021	10,237	3,700	2,347	3,238	1,816	1,621	22,959
2022	11,143	6,600	3,452	3,524	1,976	2,140	28,835
2023	11,798	15,300	5,150	3,731	2,092	2,816	40,886
2024	12,561	40,900	8,741	3,973	2,228	3,688	72,091
2025	13,209	55,600	14,103	4,177	2,343	4,802	94,234
2026	16,208	62,900	19,367	5,567	3,390	6,203	113,635
2027	19,226	68,550	26,048	6,654	4,080	7,932	132,490
2028	21,771	74,218	34,472	7,669	4,776	10,008	152,913
2029	23,639	78,174	43,749	8,403	5,275	12,413	171,652
2030	27,097	80,250	54,365	9,663	6,081	15,062	192,518
Total	166,890	486,192	211,793	56,599	34,057	66,684	1,022,214

Source: https://www.iso-ne.com/static-assets/documents/2021/02/evf2021_forecast.pdf

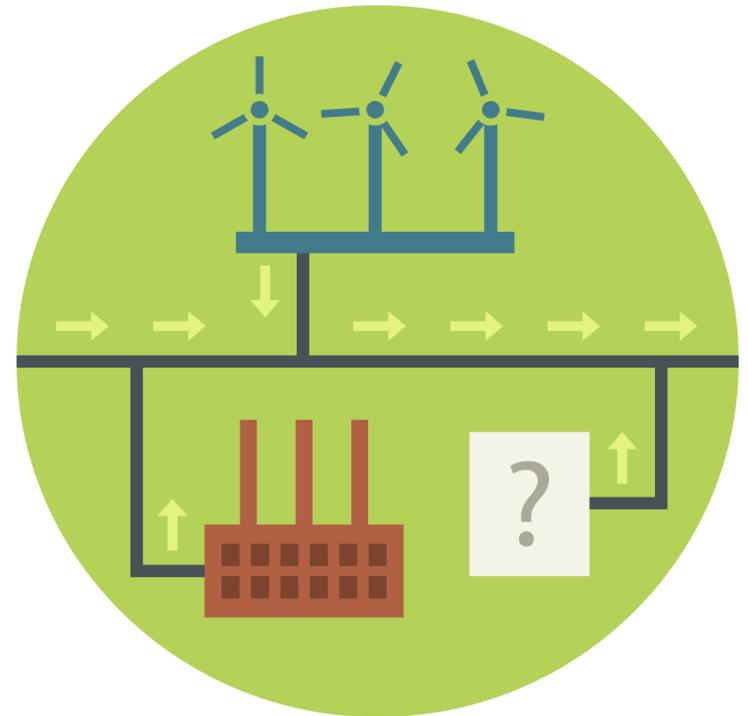
The 2021 Forecast Shows Growth in Air-Source Heat Pump Adoption

Year	Annual ASHP Installs (Thousands)						
	CT	MA	ME	NH	RI	VT	ISO-NE
2021	3.0	18.4	17.8	2.9	1.9	6.0	50.0
2022	3.5	21.1	22.2	3.9	2.3	6.2	59.2
2023	4.0	24.3	22.9	5.1	2.7	6.9	65.9
2024	4.6	42.0	23.5	5.6	3.3	7.5	86.5
2025	5.2	59.6	24.3	6.2	3.9	8.0	107.2
2026	6.1	75.5	25.0	6.8	4.7	8.5	126.5
2027	7.0	89.4	25.7	7.5	5.7	9.0	144.2
2028	8.0	103.6	26.5	8.2	6.8	9.5	162.6
2029	9.2	114.3	27.3	9.1	8.2	10.0	178.0
2030	10.6	121.9	28.1	10.0	9.8	10.5	190.8
Cumulative Total	61.0	669.9	243.3	65.4	49.4	82.2	1171.1
Approx. Share of Households with ASHP in 2030 (%) *	4.2%	23.4%	40.2%	10.9%	11.0%	29.5%	18.8%
Approx. Share of Legacy Electric Heat Replacement **	16%	15%	6%	9%	10%	5%	13%

Source: https://www.iso-ne.com/static-assets/documents/2021/02/lfc2021_final_heating_elec.pdf

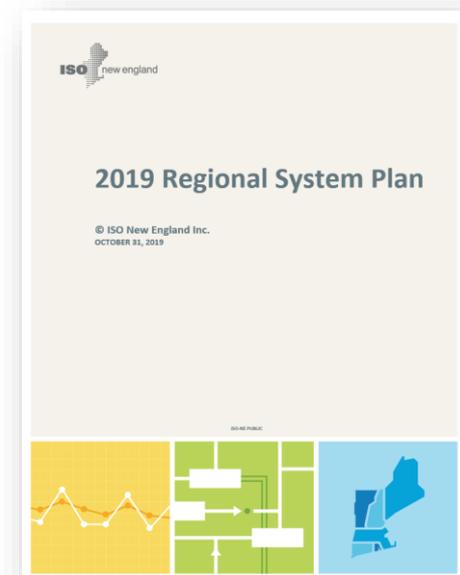
ISO New England Manages Regional Power System Planning to Meet Future Electricity Needs

- Manage regional power system planning in accordance with mandatory reliability standards
- Administer requests for interconnection of generation and regional transmission system access
- Conduct transmission system needs assessments
- Plan regional transmission system to provide regional network service
- Develop Regional System Plan (RSP) with a ten-year planning horizon



Overview of Transmission Planning

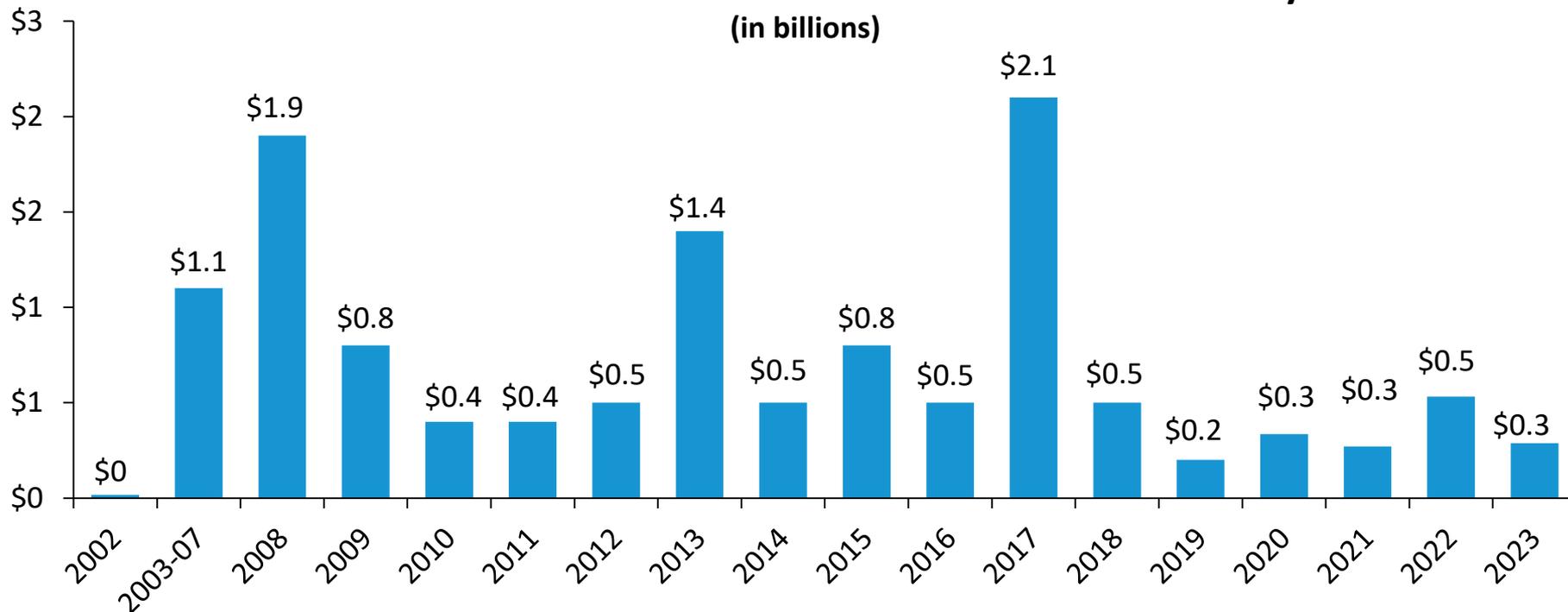
- As the **Regional Transmission Organization**, the ISO is required to identify transmission infrastructure solutions that are essential for maintaining power system reliability in New England
- Through an **open stakeholder process**, the ISO is responsible for the development of long-range plans to address future system needs over the ten-year planning horizon
 - Summarized in a **Regional System Plan (RSP)**
- The transmission planning process is governed by a **FERC-approved tariff**
- The transmission planning process has been revised to comply with the Federal Energy Regulatory Commission's (FERC) **Order No. 1000**



ISO New England 2019 Regional System Plan: https://www.iso-ne.com/static-assets/documents/2019/10/rsp19_final.docx

Region Has Made Major Investments in Transmission Infrastructure to Ensure a Reliable Electric Grid

Annual Investment in Transmission to Maintain Reliability
(in billions)



Cumulative Investment through October 2020	\$11.3 billion
Estimated Future Investment through 2023	\$1.1 billion

Source: ISO New England RSP Transmission Project Listing, October 2020
Estimated future investment includes projects under construction, planned and proposed.

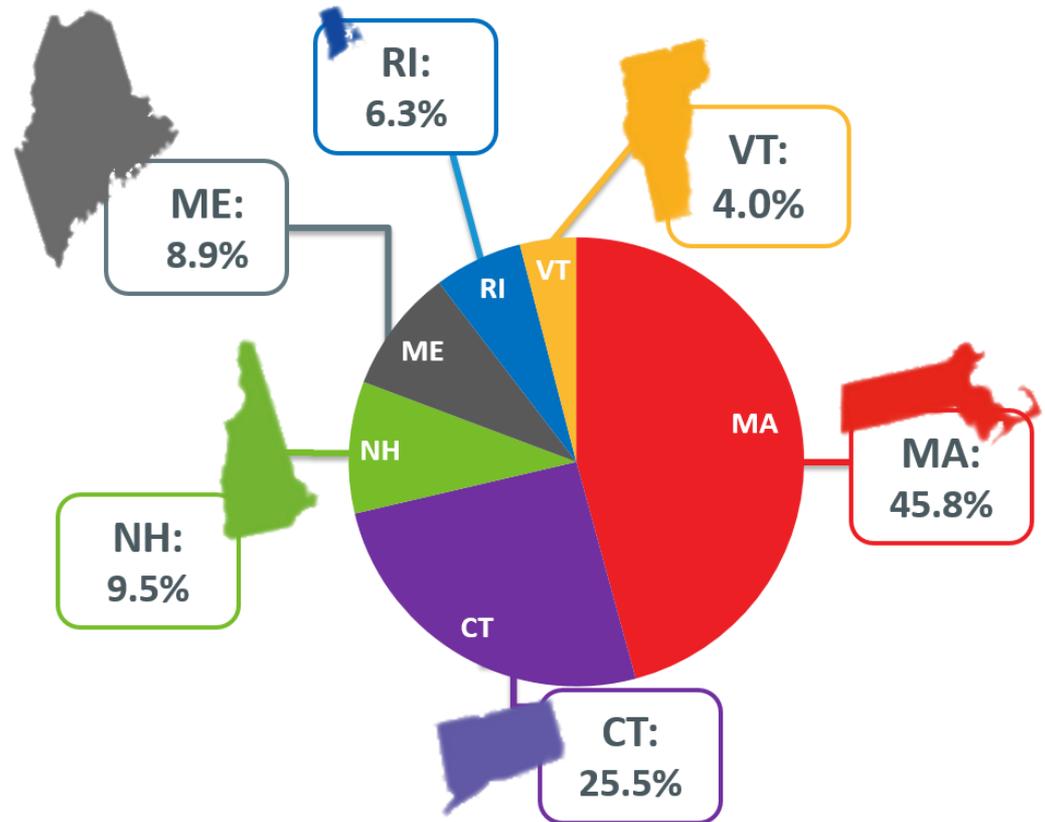
Transmission Provides Benefits Beyond Reliability

- **Transmission has reduced or eliminated out-of-market costs:**
 - Reliability agreements with certain generators that were needed to provide transmission support in weak areas of the electric grid
 - These often were older, less-efficient generating resources
 - Uplift charges to run specific generators to meet local reliability needs
- **The markets are increasingly competitive:** Easing transmission constraints into import-constrained areas has enabled the ISO to dispatch the most economic resources throughout the region to meet customer demands for electricity
- **Transmission congestion has been nearly eliminated**
- **Transmission facilitates resource transformation:** Transmission upgrades have allowed older, less efficient resources to retire, which helps the states achieve their environmental objectives



How Are Transmission Costs Allocated?

- The New England electric grid is a **tightly interconnected** system; each state shares in the benefits of reliability upgrades
- The amount of electricity demand in an area determines its **share** of the cost of new or upgraded transmission facilities needed for reliability



2019 Network Load by State

ISO New England's Vision

The ISO's Vision for the future represents our long-term intent and guides the formulation of our Strategic Goals

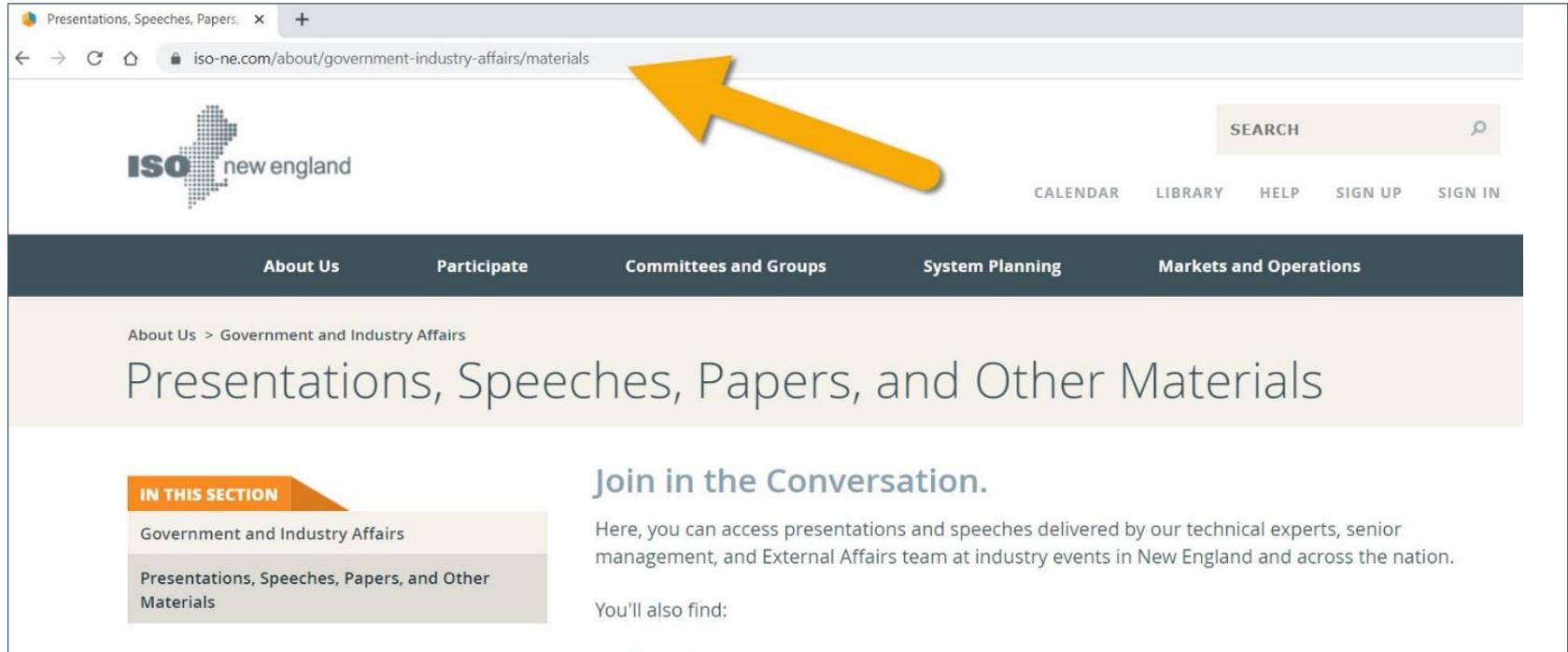


Vision Statement:

To harness the power of competition and advanced technologies to reliably plan and operate the grid as the region transitions to clean energy

Additional Resources

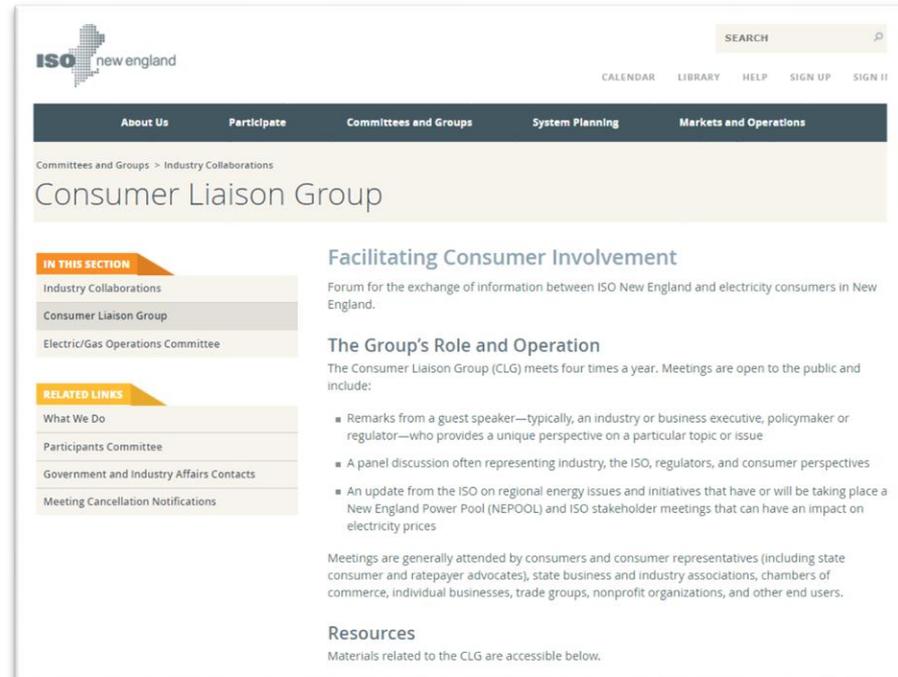
- Presentations, speeches, papers, and other materials are available on the External Affairs page
- The page is updated regularly



The screenshot shows a web browser window with the address bar containing the URL iso-ne.com/about/government-industry-affairs/materials. A yellow arrow points to this URL. The page header features the ISO new england logo on the left and a search bar on the right. Below the logo is a navigation menu with links for CALENDAR, LIBRARY, HELP, SIGN UP, and SIGN IN. A dark navigation bar contains links for About Us, Participate, Committees and Groups, System Planning, and Markets and Operations. The main content area has a breadcrumb trail: About Us > Government and Industry Affairs. The title of the page is "Presentations, Speeches, Papers, and Other Materials". On the left, there is a section titled "IN THIS SECTION" with two sub-items: "Government and Industry Affairs" and "Presentations, Speeches, Papers, and Other Materials". On the right, there is a section titled "Join in the Conversation." with a paragraph of text: "Here, you can access presentations and speeches delivered by our technical experts, senior management, and External Affairs team at industry events in New England and across the nation." Below this is the text "You'll also find:".

Join Us for a 2021 Consumer Liaison Group Meeting

- Consumer Liaison Group (CLG) meetings are:
 - A **forum** for sharing information between ISO New England and electricity consumers in the region
 - **Developed** by the CLG Coordinating Committee and **facilitated** by ISO New England
 - **Free and open** to the public
- 2021 Meetings
 - Thursday, June 17
 - Thursday, September 9
 - Wednesday, December 1

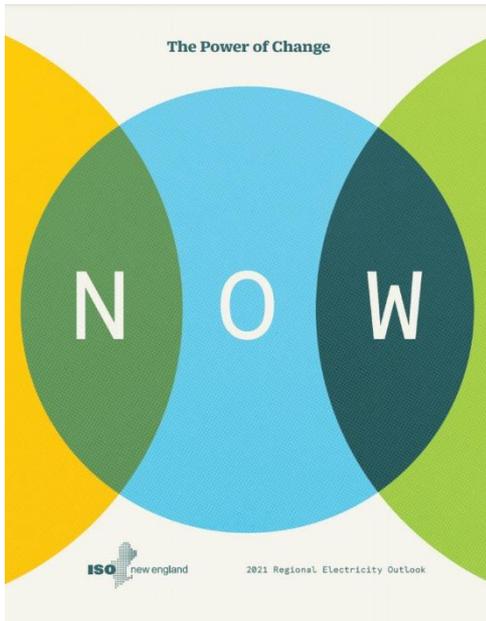


The screenshot shows the ISO New England website page for the Consumer Liaison Group. The page features a navigation bar with links for 'About Us', 'Participate', 'Committees and Groups', 'System Planning', and 'Markets and Operations'. The main content area is titled 'Consumer Liaison Group' and includes a section for 'Facilitating Consumer Involvement' with a description of the forum's purpose. Below this, there is a section for 'The Group's Role and Operation' which lists the frequency of meetings and the types of participants. A 'Resources' section at the bottom indicates that materials related to the CLG are accessible below.



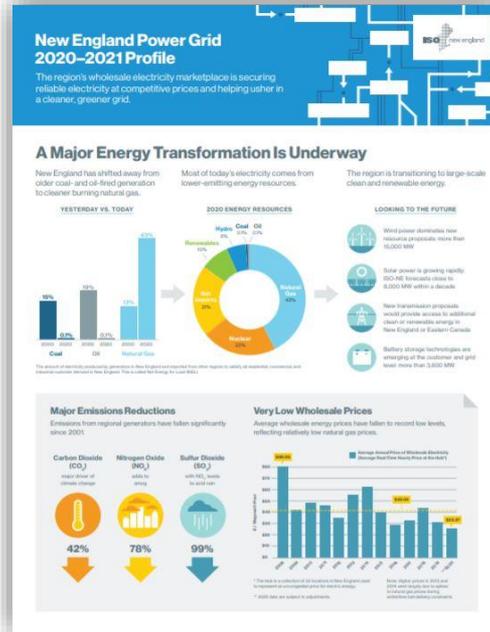
More information on the CLG is available at: <https://www.iso-ne.com/committees/industry-collaborations/consumer-liaison/>

ISO New England Recently Released Several Publications



2021 Regional Electricity Outlook

Provides a summary of ISO New England's work to lay the foundation for clean energy, studies for the future grid, and other ISO New England efforts to improve services and performance



New England Power Grid Profile

Provides key grid and market stats on how New England's wholesale electricity markets are securing reliable electricity at competitive prices and helping usher in a cleaner, greener grid



New England State Profiles

Provides state-specific facts and figures relating to supply and demand resources tied into the New England electric grid and state policies transforming the resource mix in the region

FOR MORE INFORMATION...



Subscribe to the *ISO Newswire*

[ISO Newswire](#) is your source for regular news about ISO New England and the wholesale electricity industry within the six-state region



Log on to ISO Express

[ISO Express](#) provides real-time data on New England's wholesale electricity markets and power system operations



Follow the ISO on Twitter

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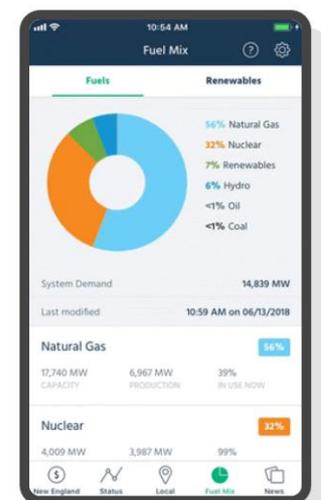


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Download the ISO to Go App

[ISO to Go](#) is a free mobile application that puts real-time wholesale electricity pricing and power grid information in the palm of your hand



Questions

